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ABSTRACT

Repeated but unadvised attempts have been made by music educators to relate the Piagetian concept of concrete operational thought to children's understanding of music. The attempts have been focused on the apparent link between the child's detection of invariance in musical patterns and the concept of conservation. These attempts are unadvised since it is generally impossible for the child to infer, as Piaget's theory requires, that musical properties remain invariant. Since processes of perception and memory are extremely important in the child's response to a musical passage that has been altered or distorted (i.e., transformed), a possibly more promising link between Piagetian concepts and the domain of music can be found in Piaget's analysis of children's response to temporally structured stimuli. The key concept to introduce in this connection is that of "expectancy". Expectancies are directly tied to Piaget's concept of schema, as investigated by Hunt and others, and to the development of the "concept of the match" between a stimulus and a preexisting schema. Children's emotional response to certain aspects of music, such as the violation of expectancies through alteration or distortion of a musical passage, appears to be understandable in terms of the growth of schemata through Piagetian processes of assimilation. More particularly, children's emotional responses can be understood in terms of the positive contribution of the experience of moderate discrepancies from schemata to children's cognitive growth. (The paper closes by drawing attention to the importance of the affective component in the response to music.) (Author/RH)

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Music and Piaget: Spinning a Slender Thread

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Abstract

While Piaget has not dealt directly with children's perception and understanding of music, there have been repeated attempts by music educators to relate his formulation of concrete-operational thought to children's understanding of music. These attempts have focused on the apparent link between the perception of invariance in responding to musical patterns, and the concept of conservation, as studied by Piaget. This linkage is questionable since it is generally impossible to infer that musical properties remain invariant, as Piaget's theory requires. Processes of perception and memory play a far greater role in the response to a musical passage subjected to transformation, suggesting that a more promising potential link between Piagetian concepts and music is in his analysis of children's response to temporally structured stimuli, in terms of their lesser susceptibility to the influence of previously presented stimuli. The paper closes by drawing attention to the importance of the affective component in the response to music. Piaget's notion of the development of the schema and his emphasis on discrepancy from schemata as a facilitator of early cognitive development is shown to be relevant to the analysis of children's emotional response to certain aspects of music, as in the violation of expectancies through alteration or distortion of a musical passage.

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Music and Piaget: Spinning a Slender Thread

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"The operations of psychological time are generally limited to the purely qualitative. But does there not exist an inner temporal metric? The most beautiful images which appear so plentifully in the work of Bergson are borrowed from music, and whenever this master of introspection wishes to express the intuitive and the antirational, the irreducible of creative time, he grasps for words of melody, rhythm, and symphony. But music is after all inner mathematics, and long before Pythagoras had discovered simple relations in harmonic chords the ancient shepherd constructed scales in his songs or pipe-playing and knew, without being able to name them, that a half-note is made up of two quarter notes, and a quarter note of two eighth-notes. Music rhythm is in fact of all temporal metrics the most directly graspable and is assuredly not foisted on us by our environment." (Translated by the writer from Piaget, 1974, p.393.)

The preceding quote, taken from the final pages of Jean Piaget's book on the formation of the concept of time (Piaget, 1974), represents the sum total of Piaget's reference to the domain of music that I have been able to uncover. I think it quite possible that Piaget, like so many great scientists, may have responded quite strongly to the world of music.² But it did not infuse him with any interest in or concern for music as part of his theory of cognitive development or of his epistemology. In fact, the realm of aesthetics, and of the arts, represent a singular gaping hole in the fabric of Piaget's ambitious, wide-ranging work. Thus one does not find it discussed even in his treatment of psychology's relationship to other disciplines, or to applied fields (e.g., Piaget, 1970).

If so, it would seem quite unpromising even to try to relate his thinking to the domain of music. Surely if we can only harp on its irrelevance for our topic, there would be little point of making room for him in our symposium. But there are at least two good reasons for doing so nonetheless. One is that Piaget's thought has infiltrated into the awareness of music educators, as it has for educators generally, and a small but growing body of research has come into being trying to apply Piaget to the domain of children's musical development. That work is worth examining, for whatever it can tell us about both the applicability of Piaget's ideas to this realm, and about the problems that need to be faced in such an endeavor.

The second reason for including Piaget in our deliberations is that by confronting the problematical character of his contribution in its applicability to music we may arrive at a clearer picture of the kind of approach that would be required to do justice to the development of children's response to music, in its perceptual and cognitive aspects at least. If, as I for one had hoped, our symposium was meant to bring out the shortcomings of psychological theory in dealing with the musical response, Piaget represents no more than a good case in point.

The role of conservation in music (if any).

To start with the Piaget-inspired research on the development of cognitive responses to music, the obvious bridge is the notion of conservation, i.e., of invariance. Invariance is of course of the essence in music: invariance of melodic or harmonic relations under changes in pitch; invariance of meter under changes in rhythm, invariance of rhythm under changes in melody -- all these, and still others that could be mentioned, play an important part in the construction of a piece of music, and presumably in the listener's response to it as well. Thus it is not surprising to find papers bearing such titles as "Conservation in musical experience" (Pfleiderer and Sechrest, 1968) and "A measure of meter conservation in music, based on Piaget's theory", (Serafine, 1979) -- to mention only two of the more noteworthy contributions to this literature.

Serafine provides a thorough review as well as critique of this research, criticizing some of it (including certain of Pfleiderer-Zimmerman's studies) for failing to ensure that the conservation in question under the experimental procedures used in fact requires a process of inference, i.e., a conceptually based understanding that some observed change has not altered an object or situation with respect to the critical dimension or attribute. It turns out however, that Serafine's own experiment, though far better constructed than most of the research on this problem, does not measure up itself in terms of this criterion. It is worth while to describe it briefly, in order to bring out the essential difficulty of applying Piaget's framework to the musical realm.

Serafine was interested in investigating the development of conservation with respect to meter, i.e., the principle that the speed of a piece of music, or more precisely the amount of time elapsed during the playing of a single bar (assuming

music that has a constant meter) is not affected by the way in which the notes within the bar are broken up. For instance, meter is conserved as one changes from a set of eight eighth-notes to sixteen sixteenth-notes. This principle sounds at first like a typical conservation question, like the temporal analogue, in fact, of the area conservation problem in the visual domain. In order to facilitate the child's responding to the meter independently of the notes within the bar, furthermore, Serafine took pains to have the start of each measure signalled by a click, and, in one of her conditions, to reinforce that auditory signal by a visual one, i.e., the flashing of a light.

Interpretation of performance on this task as indicative of conceptual understanding is reflected, according to the author, in substantial correlation of this performance with scores on a battery of Piagetian tasks, which in fact accounted for a greater proportion of variance by itself than did age. The determination of direct relationship to performance on Piagetian tasks is itself a noteworthy advance in this study over many of the previous studies, though Simon (1968), in an unpublished study carried out under my direction, had done the same for a series of tasks of musical invariance and found little consistent relationship to similar Piagetian measures. Serafine further attempted to bolster her operational-thought interpretation by showing that a special training procedure was ineffective in changing the level of performance on the meter invariance task. The import of the latter finding is a bit doubtful, in view of the problematical nature of arguing from null results. Serafine actually had hypothesized that only the children diagnosed as pre-operational would fail to improve as a result of their training, but no such selective training effects were found.

Rather than perseverating on the details of these and other findings, however, let us reexamine Serafine's procedure to see how well it conforms to the essentials of a Piagetian conservation problem. The question that poses itself is whether the child -- or anybody, for that matter -- has any way of knowing that the periods between the beats marking the bar lines remain constant, as the number of notes contained within the bar either increase or decrease. At least under the procedure used by Serafine, this is decidedly not the case. It might seem like a reasonable inference that whatever mechanism drives the clicks and flashes is unaffected by the tones sounded in between, but there is no way for the child to infer this as a necessary truth, from the givens of the situation. This is because the child does not watch

any concrete entity as it is being subjected to some readily perceived change, as in the case of altering a quantity of clay from the shape of a ball to that of a sausage, or pouring water from a glass into a flat bowl. The bar does not exist as a physical entity, since it represents but an interval of time, and there is no way for anyone to know directly whether that interval remains constant or not. I emphasize the term "directly", since it is possible to rig a situation in which some physical mechanism produces the clicks -- a metronome, for instance -- and as long as the observer can satisfy him- or herself that the metronome has not been touched, and that there has been no loss of power of the driving mechanism, the inference would have to follow that the time between beats must remain constant.

More generally it is extremely difficult to devise a good procedure that would allow one to capture this essence of invariance as something knowable, rather than merely perceived, in the realm of music, for the simple reason that music is made up of a series of intangible auditory impulses sounded over a period of time. About the only way of approximating the conservation situation is by embodying the auditory stimuli in question in some physical entity, as in the case just mentioned of metronome-produced clicks defining the meter. Better yet, one might test for conservation of melody under changes in meter or rhythm by sounding a set of clearly identifiable objects, such as chimes from a xylophone or the like, each of which produced one and only one note.

What is left, then, of Serafine's procedure, and its relevance in Piagetian terms? One answer to this question is to suggest that we are dealing here with the realm of the interrelationship between perception and conception, which Piaget concerned himself with in his analysis of perception, (Piaget, 1969). On the whole Piaget is more impressed with the differences between perception and thinking than with their similarities, and tends to differentiate between them rather sharply. For instance, he noted that the age trends in the perceptual comparison of two parallel horizontal lengths the extremities of which are staggered one relative to the other go exactly counter to those observed for the equivalent conservation of length question, where equality of the two lines is established beforehand, but one line is then displaced laterally (cf. Piaget, 1969, p.315f). At the same time Piaget did recognize various forms of a mutual interrelationship between perception and conception, the former influencing (i.e., biasing) a conceptual response in the early years, while in later years conception exerts a regulating influence on perception. A good case

in point is the alteration of a standard size constancy situation, such that a rod equal to the (near) standard is introduced, and allowed to be placed next to the variable. While adolescents and adults are able to make use of this intermediary to achieve perfect size matches, and children not as yet mastering transitivity relations persevere in their unaided perceptual judgment, there is an intermediary stage where children who have already mastered transitivity still do not make full use of it, their judgments representing a compromise between their unaided perceptual judgments and the perfect size match that an application of the transitivity principle makes possible (Piaget, 1969, p.335f).

If we attempt to apply this analysis to the case of so-called musical conservation however, we find that we are dealing at base with a perceptual judgment, and the possible contribution of an understanding of conservation in the abstract remains quite uncertain. Thus, in the Serafine case, it seems entirely possible for the perception of the speed of the beat to be affected by the speeding up or slowing down of the rhythm, even for an adult. This would represent a simple case of an illusion, a type of phenomenon well known in the field of perception. Many such phenomena are compelling enough, furthermore, to override the effects of mere knowledge, as in the case of the Gelb effect, where an object (illuminated by a concealed source of light) dramatically changes in its perceived brightness merely by the addition or removal of another object of contrasting brightness in the foreground. In Serafine's case, it may well be that an adult would on the contrary tend towards an invariance response on the basis of an assumption of the constancy of the beat, counteracting the biasing effect of the change in rhythm, aided by the sharp differentiation between the sound of the tones and that of the clicks. But the situation is inherently ambiguous, as regards the respective contributions of perception and conception.

There is, however, a more fundamental problem here that confounds the situation, as it does whenever musical stimuli are involved. This is the fact that we are dealing with a succession of stimuli structured in time, and thus making demands on processes of memory. Serafine, among others, emphasized the uncontrolled role of this factor in many of the so-called music conservation tasks used in the literature. But, rather than considering this factor in purely negative terms, i.e., as somehow obscuring the role of conceptual processes, it would be more reasonable to subject the perceptual response to musical patterns to analysis in terms of phenomena of the perception of temporally structured stimuli. This is incidentally, a problem to which Piaget contributed to a certain extent, as part of his still too

little known research program in perception. For instance, Piaget considered phenomena of temporal contrast such as the Usnadze illusion (Piaget and Lambercier, 1946) as representing Class II illusions, which increase with age. More generally, he believed that children were less sensitive than adults to effects of prior perceptual stimuli in their response to a present one (Piaget, 1969). Although the evidential basis for this belief is not altogether consistent, it is clearly a question of importance for a child's response to music. If Piaget is correct, it would suggest, first of all, that children have difficulty relating presently experienced patterns to those heard earlier -- a process that is of the essence in response to much of music, as in the discrimination of invariant aspects in theme-and-variation form, and of relationships among components in a piece of music conforming to a sonata form, for instance. One suspects that this is true, although it does not require a theory such as Piaget's to account for it. But a much more specific prediction from Piaget would be that children perceive a particular musical passage more nearly independent of the preceding, so that many tricks of the composer's trade, such as enharmonic changes, temporal inversions, etc., are likely to be lost on them. If so, is this a simple effect of inadequate memory (and long-term memory, in particular), or would it represent rather a special tendency to respond to temporal stimuli one independently of the next? Whatever the answer, the relevance of this question to the level of sensitivity to musical structure should be apparent, and thus the problem deserves the attention of both those interested in the development of perception and those concerned with music education.

At this point it appears relevant to point in passing to the typical low level of development of discrimination and perceptual sensitivity in the response of children to musical stimuli -- a phenomenon amply documented in the literature, with respect to such seemingly simple discriminations as "high" and "low" (Jeffrey, 1958; Simon, 1965), as well as the encoding of relatively simple musical patterns even with the aid of visual or tactual supports (Wohlwill, 1971). It seems that the domain of audition has been reserved, by and large, to the detection and discrimination of speech sounds, and that in general (though obviously not for musically gifted individuals) the level of development attained by the individual in this realm of perception is not very advanced. Undoubtedly it is susceptible to training, just as work in the realm of passive touch has shown (e.g., Geldard, 1957). At the same time the actual level of development of a child with regard to musical discrimination needs to be carefully determined in any research on children's perception or understanding of music, whether Piagetian or not.

Piaget and the affective side of music

For all the breadth commonly associated with the work of Piaget, he remains essentially the genetic epistemologist -- that is, his concern is for the processes of the acquisition of knowledge and logical thought, virtually to the exclusion of other aspects of development. For several reasons (among which his own experience in psychoanalysis may well be one) the realm of affect represents a partial exception to this rule, to the extent that he felt himself impelled at various points to comment on the relationship between cognitive and affective development (e.g., Piaget, 1976). It cannot be said that this extension of his thought has contributed any very insightful new ideas to this problem area, much less new facts. For the most part he contented himself with the formulation of a rather facile isomorphism between cognition and affect (cf. Cowan, 1978). On the one hand, he held that there can be no emotion without cognition -- though it is not clear whether in this instance "cognition" need imply much more than the presence of certain stimuli perceived by the organism, as in the case of the "releasing stimuli" postulated by the ethologists, to whom Piaget refers in this specific connection. On the other side of the ledger, Piaget held that cognitive processes are generally accompanied by certain affective, i.e., motivational states, whether low-level ones evoked by some decision or judgment process, or more potent ones such as might be evinced by a child in the process of trying to achieve equilibration, when caught between two mutually contradictory modes of thoughts or judgments.

None of this, clearly, is of much value to us in considering the child's response to a piece of music. There exists, however, a potential link between Piaget's account of early cognitive development and affective response to temporally structured stimuli that I should like to dwell on briefly to conclude this paper.

Schemata and Expectancies

I should like to suggest that the key concept to introduce in this connection is the one of expectancy. The role of expectancy in music has of course been emphasized in various accounts of musical aesthetics, notably those of Bisset (1921) and Meyer (1956); it is at least potentially closely linked to informational analyses of music such as those of Moles (1965) and Cohen (1961). At the same time expectancies are directly tied to Piaget's concept of Schema, as he developed it for the

analysis of the early sensori-motor development of the child, which has served as a basis for an important line of research investigating response to deviations from a pre-existing schema (Lewis and Goldberg, 1969; McCall & Kagan, 1967), it has been picked up by Hunt (1961, 1965) and others, furthermore, (e.g., Wachs, 1978) in the form of the "concept of the match", between a stimulus and a pre-existing schema, leading to the postulation of limited discrepancies between the two as providing the motivational dynamics for cognitive growth.

Let us try to sketch out some possible extensions of this formulation to a child's response to music.

Let us assume that we are dealing with an American Kindergarten-age child, who has had the usual amount of experience with simple children's songs such as "Mary had a little lamb" and "Yankee Doodle". Through repeated experience in hearing as well as singing such tunes the child develops a schema for each song, corresponding to the schemata of the major objects of his or her visual world. The fact that these schemata consist of temporally structured patterns introduces a new dimension into the response to schemata, which appears particularly rich in possibilities for affective reactions.

Take, to begin with, the recognition response to a familiar melody. An encounter with an ordinary familiar object would not be expected to elicit a pronounced affective reaction, unless it represents a social stimulus with strong affective connotations for the child, or perhaps an object that has been missed for some time and has now been found. The matter seems different, however, in the case of such a melody. This is because each note sets off the expectation of one to follow, and the satisfaction of this expectation can be assumed to be pleasurably experienced by the child, at least when cumulated over the course of a whole tune. Reinforcing this effect of the temporal sequencing of a melodic pattern are undoubtedly the effects of rhythm, not only because strong rhythmic pattern encourages motoric involvement on the part of the child (clapping, dancing, stomping), but also because such patterns heighten the sense of expectancy that they generate (consider the strong anticipation of the fourth note of the introductory phrase of Beethoven's fifth symphony, in comparison, say, to the response to the introductory notes of the slow movement of Haydn's Surprise symphony).

There is thus a constant source of affect built into the response to such familiar musical patterns, based on the match between the pattern encountered and the schema already established for it, though that schema itself undoubtedly becomes more clearly articulated, and perhaps corrected, with each successive exposure (up to some point at which the tune has become overlearned).

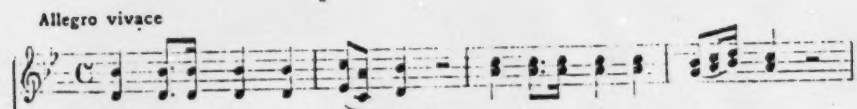
The more interesting question, however, concerns the child's possible response to deviations from expectancy, which Meyer has argued play such a crucial role in the realm of music. Such deviations appear relatable to the growth of schemata through assimilatory processes described by Piaget, and more particularly to the positive role of moderate discrepancies from schemata discussed by Hunt as a contributor to cognitive growth. Let us consider a few possible phenomena that fall into this class.

First of all, it should prove possible to provide an auditory analogue of the "Peek-a-Boo" effect, with its well known power to evoke expressions of laughter and delight in a very young child. The response is presumably set off by the alternation of occlusion and sudden reappearance of a familiar sight, notably the face of the mother or some other significant social object. An approximate analogue to this situation, though not a perfect one, might be the effect, in the case of a familiar tune, of omitting certain portions of it, i.e., letting a phrase of the music run its course without being actually heard, or sung, as is sometimes done for a certain verse of a familiar tune that has already gone through a number of repetitions through previous verses. The child's schema supplies the missing phrases at an imaginal level, but the reappearance of the music itself can be expected to provoke a delight comparable to that of the reappearing mother in the peek-a-boo game, except for the lack of the element of suddenness that is a feature of that game.

Outright gross violations of expectancies, for instance through the insertion of deliberate wrong notes, or an unusually high or low note at the end of a tune, can be similarly expected to result in laughter or delight, just as incongruity -- i.e., violation of a previously built up expectancy -- has long been found to be a prime factor in humor, as seen, for instance in McGhee's (1979) developmental theory of humor.

Surprise and incongruity have of course been exploited for some time by composers wishing to create humorous effects (think of Mozart's "A Musical Joke", or Strauss's "Ty1 Eulenspiegel"), though there is little empirical research available on such effects, either for adults or children. (In a dissertation currently under way at Penn. State, Fox (Note 1) is attempting to measure responses of smiling and laughter to tones that are highly discrepant from a previously encountered series.)

But the violations from expectancy that Meyer talks about are of course of a more subtle kind. Which is not to say that the concept cannot serve as a fruitful basis for research on musical aesthetics, and of developmentally oriented research in particular. At this point however, the analysis comes full circle, since in most cases the expectancies that are violated by a composer for a certain effect represent deviations from musical invariances, and the response to such deviations needs to be considered in the context of the response to the invariance itself. Consider, for instance, the opening of Mozart's Piano Concerto in B-flat, K.456.



invariance from some overall change imposed on the theme, along with more specific alterations, and even distortions of the theme. Because of the relative structural simplicity of this musical form, it suggests itself for use with children. There exist, in fact, a number of well-known sets of variations based on nursery songs that would already be familiar to many children (Mozart's as well as Dohnanyi's on "Twinkle, twinkle, little star", for instance). It should prove possible to subject the child's response to such variations to systematic study, in terms of the recognition of the theme under changes imposed on it leaving its basic structure invariant, as well as the discrimination of an alteration in the theme itself that should act as a deviation from expectation, assuming a well-structured schema corresponding to the theme at the outset. This approach should allow us to trace the kinds of general transformations that will preserve perceived invariance as a function of the child's development and musical experience, as well as to determine the sensitivity to alterations, and accordingly the response to violated expectancies, and the affective reactions to them. A promising line of research suggests itself in this regard. It will not consist of a Piagetian approach, to be sure. Rather, it will allow us to fill in the considerable gaps left by Le Patron in his more ratiomorphic than aesthetic account of the individual's perceptual and cognitive development.

Footnotes

¹This paper was written for presentation at the symposium on "Of musical charms and noisy theories" held at the Meetings of the American Psychological Association, Los Angeles, August 1981.

²The surmise is indeed correct, as Bringuier (1980, p. 124f) reports in his Conversations with Jean Piaget. Piaget admitted to "listening" to classical music while working on a problem, either for "general stimulation" (for which he preferred dramatic selections such as the death of Boris from Boris Goudunoff) or for "construction," i.e., intellectual inspiration, for which he would choose highly structured music such as Bach. These comments were, however, given in very incidental fashion, at the tail end of a discussion about memory, and were in fact initiated by Piaget asking his interlocutor whether he liked music. Thus these off-hand remarks only reinforce the point being made, that Piaget was not interested in incorporating the response to musical stimuli, or its development, in his broader theoretical scheme.

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